

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
11 January 2001 (11.01.2001)

PCT

(10) International Publication Number
WO 01/02535 A2

(51) International Patent Classification⁷:

C12F 3/00

(74) Agent: LANGROVÁ, Irena; Skrétova 48, 301 22 Plzen (CZ).

(21) International Application Number: PCT/CZ00/00047

(81) Designated States (national): AU, BA, BG, BR, BY, CA, EE, HU, IN, JP, LT, LV, MD, MK, MX, NO, NZ, PL, RO, RU, SI, SK, TR, UA, US, ZA.

(22) International Filing Date: 26 June 2000 (26.06.2000)

(84) Designated States (regional): European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

(25) Filing Language:

English

Published:

— Without international search report and to be republished upon receipt of that report.

(30) Priority Data:

PV 2389-99 1 July 1999 (01.07.1999) CZ

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(71) Applicant and

(72) Inventor: ŠAŠEK, Karel [CZ/CZ]; Kubelíkova 1265/41, 130 00 Praha 3 (CZ).



(54) Title: THE METHOD OF ETHANOL PRODUCTION WITHOUT THE RISE OF DISTILLER'S STILLAGE

WO 01/02535 A2

(57) Abstract: A method of processing agricultural materials such as grain, sugar-beet or potatoes. Grinded grain is first mixed with water and after the addition of liquifying and saccharifying enzyme, the risen mash is submitted to fermentation. Sliced sugar-beet is submitted to fermentation and after saccharifying of starch, crush potatoes are submitted to fermentation like in case of grain. The fermented mash is filtered under condition of overpressure on the side of suspension, the colature is conveyed to distillation and the filter cake is predried in the drier under a temperature higher than the temperature of boiling-water given used pressure, from where the by predrying ejected reminders of ethanol with water are conveyed to further cooling down, liquefying and distillation, while the filter cake without ethanol is then dried in the end-drier. In the advantageous practise, the filter cake is washed with water after the filtration, and the liquid phase is pushed out using inert gas. There is an atmosphere of inert gas being maintained in the drier during predrying. In a process of ethanol production for food quality the water solution of ethanol reminders, acquired during predrying, after being cooled down and liquified, is conveyed to the fusel column of technical ethanol. In a process of ethanol production for non-food quality the water solution of the reminders of ethanol acquired during predrying, after being cooled down and liquified, is mixed with the filtrat. In an alternate design grinded grain straw is added to the fermented mash in a proportion of max. 15% of the weight

The Method of Ethanol Production without the rise of distiller's stillage

The Area of Technique

The invention concerns the method of ethanol production without the rise of distiller's stillage from agricultural products such as grain, sugar-beet or potatoes.

The State of Technique

The fermented mash was until now conveyed to the distillation, i.e. to the mash column, where all the ethanol was boiled down, that also includid in the solid phase of treated raw material. But it led to the destruction of yeats and to the escape of very valuable materials such as proteins and vitamines, to the solution, from where they are very difficult to get back. The risen distiller's stillage were usually added to bulky fodders for cattle. But the great propensity of the distiller's stillage to destruction limits this utilization. Recently, the distiller's stillage are being poured out to the fields.

Nowadays, there is a technique being used in France, that thickens the distiller's stillage in a cascade of evaporators approximately to 25% of dry matter. Afterwards, grain groats are added, causing the risen very viscose liquid to thicken and making its further drying and granulation possible.

The Nature of Invention

The method of ethanol production, according to the presented invention, processes the agricultural products such as grain, sugar-beet and/or potatoes. The grinded grain is first mixed with water and after the addition of liquifying and saccharifying enzyme, the risen mash is submitted to fermentation, the sliced sugar-beet is submitted to fermentation and the crush potatoes after the saccharifying of the starch, like in case of the grain. When using this method, the solid part is worked to the fodder for farming animals.

The nature of this invention consists in that the fermented mash is being filtered under the condition of overpressure on the side of suspension, the filtrate is conveyed to distilation

-2-

and the filter cake is predried in the drier with a temperature that is higher than the boiling-water temperature, given the pressure used. By predrying ejected reminders of water and ethanol are conveyed away from the drier for cooling down and liquifying. After that, they are conveyed to distillation. The filter cake without the ethanol is dried in the end-drier.

In the advantageous practise, the filter cake is rinsed with water after the filtration, and the liquid phase is pushed out using inert gas. There is an atmosphere of inert gas being maintained in the drier during predrying.

During the production of ethanol on food quality the water solution of the ethanol reminders, which is acquired during predrying, after being cooled down and liquified, is conveyed to the distillation in an fusel column of technical ethanol.

During the production of ethanol on non-food quality the acquired solution of the reminders of ethanol is mixed with the filtrat.

In an alternate problem solution the grinded grain straw is added to the fermented mash in a proportion of max. 15% of the weight.

The advantage of the proposed problem solution is the removal of the rise of distiller's stillage, which enables the development of surplus agricultural products processing and the use of the ethanol made as an addition to the fuel for engine vehicles.

Another advantage is the possibility of the single recirculation of the water used for production. It reduces the amount of water needed for production to one half and it reduces the amount of the outlet water to one half as well.

The problem solution reduces the losses of the valuable materials contained in yeats, such as proteins and vitamines.

-3-

During the suggested method, the solid phase are not exposed to the high temperature and the time of the exposure is shorter. This avoids the deep destruction of materials such as proteins and vitamines as it was the case during the existing processes.

The next advantage is, that the process of the acquisition of the dry matter of insoluble phase from the agricultural materials is investively cheaper and technologically simpler than the processes known until now.

Examples of Performing of the Invention

Example No. 1

The mixture of grain (wheat, rye, barley in proportion 1:1:1) is grinded and mixed with water of 50°C temperature, where the liquifying enzyme is added in. The temperature of water was acquired by mixing the boiling water, leaving from the mash column, with fresh water. The mixture is being heated with direct steam to the temperature 70°C. After a pause of approximately 10 minutes lenght, the mixture is cooled down to temperature of 55°C, and saccharifying enzyme is added. After another pause, the mixture is cooled down to the inoculum temperature, which is 27°C, and is conveyed to ferment tank. The from the fermentation process escaping carbon dioxide is watered in the column with cold water. The scrubbed carbon dioxide from the first fermentation phase is released to the atmosphere and the scrubbed carbon dioxide from the second fermentation phase (the second scrubbing column) is collected for future use. Fermented mash is filtered through the filter press and is conveyed to distillation.

The filter cake is washed the water used for scrubbing of carbon dioxide heated to the temperature of 35°C, next the liquid is pushed from the filter cake using carbon dioxide, and this share is being added to the filtrat. Next, the filter cake is then moved to the disk drier, that works with lowered pressure and in an inert atmosphere of carbon dioxide and where share of ethanol, that was kept in the solid phase, is removed and the content of water is reduced to approximately 40% of the weight. After liquifying of the streams and

-4-

separation of carbon dioxide is the solution of ethanol being drawn to the column of technical ethanol, i.e. to the fusel column. The predried cake is conveyed to the shelf drier, where it is dried to a water content of approximately 10% of the weight, suitable for further processing.

Example No. 2

The sliced sugar-beet is heat with direct steam to a temperature of 27°C; it can also be mixed with water so that the content of saccharose is 15% of weight. Next, it is conveyed to the fermentation tank and is inoculated and fermented. The escaping carbon dioxide is scrubbed and caught. During secondary fermentation, the grinded straw is added to the mash in a proportion of max. 15% of weight. The next process is the same as the example no. 1, with the difference that the ethanol is determined to next production as the fuel addition, that is why the liquid streams of ethanol and water from the disk drier are mixed with filtrat.

Industrial Application

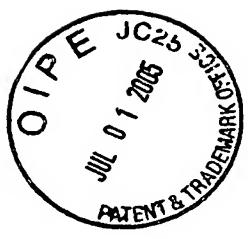
The problem solution according to the invention can be used in destillary, with advantage for processing of surplus agricultural materials.

Patent Claims

1. The method of ethanol production without the rise of distiller's stillage from grain and/or sugar-beet and/or potatoes, where grinded grain is first mixed with water and after addition of liquifying and saccharifying enzymes, the risen mash is submitted to fermentation, sliced sugar-beet is submitted to fermentation and crush potatoes are submitted to fermentation after the saccharifying of starch as in case of grain, characterized by, that the fermented mash is being filtered under the condition of overpressure on the side of suspension, the filtrat is conveyed to distillation and the filter cake is predried in drier in temperature higher than the temperature of boiling water given the pressure used, from where the by predrying ejected reminders of ethanol with water are conveyed to further cooling down, liquifying and to distillation, while the filter cake without ethanol is being dried in the end-drier.
2. The method of ethanol production without the rise of distiller's stillage according to the claim 1., characterized by, that the filter cake is washed with water before being placed in the drier and the liquid phase is pushed out with an inert gas.
3. The method of ethanol production without the rise of distiller's stillage according to the claims 1. and 2., characterized by, that during the production of ethanol on food quality the water solution of reminder of ethanol acquired by predrying, cooling down and liquifying, is coveyed to distillation to the fusel column of the technical ethanol.
4. The method of ethanol production without the rise of distiller's stillage according to the claims 1. and 2., characterized by, that during the production of ethanol on non-food quality the water solution of reminder of ethanol acquired by predrying, cooling down and liquifying, is being mixed with the filtrat.
5. The method of ethanol production without the rise of distiller's stillage according to the claims 1. and 2. and 3. or 4., characterized by, that grinded grain straw is added to the fermented mash in a proportion of max. 15% of the weight.

-6-

6. The method of ethanol production without the rise of distiller's stillage according to the claim 1., characterized by, that an inert gas atmosphere is being maintained in the drier during predrying.



THIS PAGE BLANK (USPTO)